Aalto University
School of Business | Mikkeli Campus

STRATEGY BEHIND FINNISH INNOVATION POLICY ON THE MISSION TOWARDS CARBON NEUTRAL FINLAND

Miika Lassinen

International Business
Bachelor's Thesis
Supervisor: Heikki Rannikko
Date of approval: 9 April 2021

Aalto University
School of Business
Bachelor's Program in International Business
Mikkeli Campus

Aalto University
School of Business | Mikkeli Campus

STRATEGY BEHIND FINNISH INNOVATION POLICY ON THE MISSION TOWARDS CARBON NEUTRAL FINLAND

Miika Lassinen

International Business
Bachelor's Thesis
Supervisor: Heikki Rannikko
Date of approval: 9 April 2021

Aalto University
School of Business
Bachelor's Program in International Business
Mikkeli Campus

AALTO UNIVERSITY
SCHOOL OF BUSINESS
Mikkeli Campus

ABSTRACT OF
BACHELOR'S THESIS

Author: Miika Lassinen
Title of thesis: Strategy Behind Finnish Innovation Policy on the Mission Towards Carbon Neutral Finland

Date: 9 April 2021
Degree: Bachelor of Science in Economics and Business Administration
Supervisor: Heikki Rannikko

Objectives
The main objectives of this study were to examine strategic side of Finnish innovation policy and its use in reaching carbon neutrality. Another objective was to compare and benchmark the Finnish innovation policy to Swedish and Norwegian innovation policies to find differences which help reaching carbon neutrality.

Summary
First the strategic side of Finnish innovation policy was reviewed in relation with carbon neutrality. Then, the study benchmarked Finnish innovation policy against Swedish and Norwegian innovation policies to find differences which help in reaching carbon neutrality. Finally, these differences were used to create suggestions for possible improvements to the Finnish innovation policy to help Finland reach carbon neutrality by 2035.

Conclusions
The main conclusion of this study is that there are differences between Finnish, Swedish and Norwegian innovation policies, which can be used to improve Finnish innovation policy. For example, decentralization of decision-making, a platform for evaluation and collaboration, increasing budget outlay for R&D, and innovation of concrete solutions to carbon neutrality through applied deployment of knowledge.

Key words: ***carbon neutrality, innovation policy, governance, innovation finance, research organizations***

Language: English

Grade:

AALTO UNIVERSITY SCHOOL OF BUSINESS
Bachelor´s Program in International Business
Mikkeli Campus

OUTLINE
Bachelor's Thesis

COVER PAGE
TITLE PAGE
ABSTRACT

Table of Contents

1. INTRODUCTION

Governments have a significant role in the battle against climate change (Dahal et al., 2018). To alleviate the severity and mitigate the effects of climate change, Finland has taken serious action towards the mission of carbon neutrality (Valtioneuvosto, 2020). Innovation policy plays a vital role in allocating resources as well as in steering R&D and innovation into right direction (Aro & Heiskala, 2015; Takalo & Toivanen, 2018). After understanding the strategic side of the Finnish innovation policy and how it is utilized in the mission towards carbon neutrality, ideas for improvements can be obtained through a comparison between Finland's innovation policy strategy with other countries strategies in reaching carbon neutrality.

1.1. Background

According to Sanna Marin's (current Prime Minister of Finland) government programme, Finland has a target of reaching carbon neutrality by 2035. Reaching carbon neutrality is possible through carbon reductions and carbon sinks (Valtioneuvosto, 2020). Many of the previous literature focus on the strategic side of Finnish innovation policy (e.g. Aro & Heiskala, 2015; Takalo & Toivanen, 2018; Koski et al., 2019), but not on the issue of its use in reaching carbon neutrality. Studies which address carbon neutrality (e.g. Lehtilä et al., 2014; Dahal & Niemelä, 2016; Karhunmaa, 2018; Pilpola et al., 2019) can be used to make connections with the Finnish innovation policy strategy. This paper focuses on how the Finnish innovation policy strategy is tuned in the process of reaching carbon neutrality.

1.2. Research Problem

The research problem is to investigate and gain knowledge on the ways the Finnish innovation policy plays a role in the process of Finland becoming carbon neutral. Another research problem is to analyse the strategic effectiveness of the current innovation policy towards carbon neutrality and the potential challenges that could arise along the way.

1.3. Research Questions

Based on the research problem, this thesis answers the following research questions:

1) What differences are there between Finnish, Swedish and Norwegian innovation policies in how they help to reach carbon neutrality goals?
2) What are the enablers of carbon neutrality and barriers to reach carbon neutrality?
3) In what ways can Finland improve its innovation policy to reach carbon neutrality by 2035?

1.4. Research Objectives

The objectives of this study are the following. First, previous studies on the strategic side of Finnish innovation policy and its use in reaching carbon neutrality are reviewed. Then knowledge gaps are identified based on the literature review and research questions are formulated accordingly. Second, empirical data on Finnish, Swedish and Norwegian innovation policy strategies towards carbon neutrality is collected and analyzed to find answers to research questions. Third, findings are presented, their significance for the literature is discussed and conclusions are drawn. Finally, limitations of the study are presented and possible further research avenues are pointed out.

1.5. Key Definitions

Innovation policy – policy tool used by the government to foster innovation towards a desired direction (Takalo & Toivanen, 2018).
National innovation system – a system that connects education, R&D, growth and welfare together through innovation (Aro & Heiskala, 2015). Freeman introduced this concept in 1987 as “the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies” (Frenken, 2017: 37).
Carbon neutrality – when net carbon emissions equal to zero

2. LITERATURE REVIEW

Before discussing the Finnish innovation policy strategy in reaching carbon neutrality and comparing it to the strategies of Sweden and Norway, it is necessary to review previous literature on the issue. This literature review explores the Finnish innovation policy and its use on the progress towards carbon neutral Finland. In addition, it tries to address the enablers and barriers to carbon neutrality, and how the strategy of Finland could be altered to ensure reaching the objective.

2.1. Finnish Innovation Policy as a Strategic Tool

Finland is a knowledge-based economy and it has strong capabilities to innovate (Suorsa, 2007). The National Innovation System of Finland was first introduced in the 1983 when the Finnish Funding Agency for Technology (Tekes, now known as Business Finland) was founded. This was the first time research centers, universities, businesses and authorities were able to cooperate with Academy of Finland and seek for possible innovation opportunities and solutions (Aro & Heiskala, 2015). Koski et al. (2019) describe the objectives of the Finnish innovation policy in two distinctive levels: outer and inner level. The outer level includes improving the existing knowledge base, funding new innovative ways that could foster growth, increasing the level of international collaboration, and ensuring high quality of R&D and innovation. The inner level, or the core, considers productivity, economic growth, welfare along with employment, and how to deal with societal challenges. Carbon neutrality is one of these challenges. When it comes to society, socio-cultural side of the policy needs to be considered as well. For example, Dahal et al. (2018) argue, that not only the policy needs to be cost-effective, but it also needs to be politically and socially accepted. This is exceptionally important when the Finnish innovation policy is evaluated in terms of its effectiveness.

While this thesis is about the Finnish innovation policy and how Finland applies it to become a carbon neutral country, the ideas behind the Finnish innovation policy on a more general level should be considered before going deeper. The next few parts will explore the theoretical side of the innovation policy, such as the economics of it,

different possible approaches, and the effectiveness of the current Finnish innovation policy.

2.1.1. Economics of Finnish Innovation Policy

Innovating and making the use of new ideas and technologies have been the major reasons for Finland's economic success. This was seen clearly in the 90s when innovation played a big role in the recovery from severe recession when global competition became stronger (Aro & Heiskala, 2015). It should also be noted that at this time innovation policy started to play a major part in economic policy, although there can sometimes be misunderstandings in terms of how innovation policy can influence the economy (Frenken, 2017). Cai et al. (2018) argue that the Finnish innovation policy should be handled and understood as a mix of policies which fosters institutional change to the society. In addition, the innovation policy is about adaptation as well as learning of how to efficiently use resources in order to get what is intended and leverage growth. However, up to date, Finland is moderately lagging in digitalization and R&D funding is not as high as it should, which in turn, leads to weaker incentive to innovate. This all boils down to core of the innovation policy which addresses economic growth which is one of the major issues Finland has been struggling with (OECD, 2017; Koski et al., 2019). It seems that Finland needs to improve their present economic state through their innovation policy, so that Finland does not fall too much behind on a global scale.

Finland is a country that focuses on welfare, and this is something to keep in mind when the innovation policy is analyzed and assessed. Finland's innovation policy relies on tax credit and subsidy policies, but tax reliefs or other innovation policy techniques, such as prizes could also be used more than now. It is also questionable whether current innovation policy increases welfare after all expenses are counted in (Takalo & Toivanen, 2018). However, it looks like that Finnish economic policy, especially the innovation policy has worked effectively before. For example, the introductions of Nokia and later the global gaming company, Supercell, are illustrations of how innovation can be successful. Not only these, but also social indicators such as inequality, crime, and quality of living are at high standards. This shows that Finland is

a very competitive country. Although Finland is outlined as a laissez-faire market economy, where the government power is rather limited, social trust and connectivity give Finland an advantage when it comes to the field of R&D and technology development (Parella, 2019). This supports the idea that Finland has the capabilities of making their innovation policy as economically effective as possible.

Takalo and Toivanen (2018) also refer to the ideas of intensive and extensive margins and their relationships with the Finnish innovation policy. The innovation policy could be aimed at the extensive margin to the society's perspective and welfare, or more towards the intensive margin and subsidize also large existing firms in their R&D projects. The problem is that a large proportion of the latest successful innovation projects bloom from start-up businesses. Therefore, a good method is weighing up the possibilities as there is no scenario where all consumers benefit from the innovation policy without any wasted resources or unintended costs.

2.1.2. Bottom-up and Top-down Approaches

There are different approaches which the government and the policymakers can take with innovation policy. Innovation policies are usually based on a micro-level, bottom-up approach, or more macro-level, the top-down approach. Sometimes governments want to mix both approaches together if situations require. Even though carbon neutrality might sound like a specific and a straightforward mission, it is still quite complex, and it concerns multiple smaller projects that are conducted by both private and public sectors (Mazzucato, 2018). Moreover, innovation and completing a mission is not without errors so it involves rigorous experimentation and see what works and what does not.

If the government wants to be in better control where to invest and which projects to fund, top-down approach is a viable option as it gives more power to do so (Alaja, 2017). Top-down approach is also known as mission-oriented approach. Mission-oriented approach enhances the meaning of what kind of role the government has in innovation challenges. Missions like reaching carbon neutrality, have a direction and a societal importance, and they are realistic as well as time bound. United States is good example of a mission-oriented country (Alaja, 2017). It is vital that the mission is cross-

industrial so that it will stimulate innovation also in non-obvious places. This way there can be better results and the outcome will be more comprehensive. For example, with carbon neutrality, the mission should not only be focused on transportation or energy solutions, but it could also involve digital innovation, artificial intelligence and perhaps designing. With all these six factors listed in place, it is probable that the whole mission is more cost-efficient, different industries collaborate more which shapes the markets, and most importantly, wider reach in strategic directions that will be used to continue building a better future (Mazzucato, 2018). If it does not incorporate all six factors, the mission might still be accomplished, but it would be likely that it is inefficient or not sustainable. Also, as was already discussed before by Koski et al. (2019), the innovation policy should also be about collaboration and working together towards a common goal.

Arguably top-down and mission-oriented approach could lead to effective innovation policy, but bottom-up approach provides a more conservative approach as it based on standard economic thinking of market failure. However, it might give the government too little power, and often there is the risk that private parties will not put enough money into R&D due to market failure (Alaja, 2017; Frenken, 2017; Takalo & Toivanen, 2018). Bottom-up approach enables actors outside the government (e.g. firms) influence the direction of innovation. They only have to follow government's objectives. The Finnish innovation policy is more bottom-up at the moment which seems to be due to Finland wanting pragmatism (Alaja, 2017). Pragmatistic bottom-up approach can be seen as a safe route to take; however, it can also be too narrowly focused. Focusing on one sector or a firm, for example Finland concentrating heavily on ICT sector and Nokia, is an example of narrow focus and how it can lead to unsustainable innovation.

When thinking about which approach would suit the best for Finland, we have to remember that there is no one good solution that works in every situation (Fagerberg, 2017). Benevolent government could be assumed, but that does not make the government certain whether the chosen approach will be the better option than the other (Takalo & Toivanen, 2018). There needs to be a strong collaborative network between firms, innovative individuals and institutions. In addition, regions need to be connected with each other as well (Suorsa, 2007). Frenken (2017) adds that generic innovation policies, that are based on the standard of market failure, and only throw money at problems through R&D funding, tend to produce only mediocre results which

could have been avoided or improved by being more mission-oriented, like outlined by Mazzucato (2018). However, once the innovation policy is thought to be working fine, there should be regular monitoring and adaptation to ensure strong performance. If some sectors show success in terms of innovation, it might be a decent idea to use resources in places where they are used effectively.

2.1.3. Should Innovation Policy Create Markets or Fix Markets?

Market creating and market fixing are relevant concepts to discuss after we have gained more understanding how different approaches influence the innovation policy and the effects caused by them on the journey of accomplishing societal challenges. The question is that should the innovation policy be more careful and concentrate on fixing the existing market, or whether it would be a better idea to create whole new markets. Nevertheless, public spending towards R&D and innovation is one factor that should be increased. But when government spending increases, crowding out is one possible issue. This is problematic because as innovation finance is increased by the government, it can decrease the initiative of firms doing their own R&D projects. At the same time, innovation by private sector is valuable and it should be encouraged. Public intervention like this enhances the way governments see the society's response to the innovation policy (Dechezleprêtre et al., 2016). According to Mazzucato (2016), this leads the government to a situation where they are better off with experimenting the correct balance of funding and see how the outcome reflects on the costs. This reflects to idea that government should try to provide the suitable conditions that boosts innovation and transform the innovation system, not just maintain its current state. Innovation policy should be aimed at creating difference without limiting the system only on encouraging increased innovation, which is not that common yet (Fagerberg, 2017; Grillitsch et al., 2019).

Apart from market failure, there is also one another concern which relates to the national innovation system itself. A system failure can occur if there are underperforming individuals or firms, or poor connections between them in the national innovation system. The Finnish government should actively evaluate the functioning of their innovation system. Firstly, the key in improving the system itself is to boost the

interaction, although it only works to a certain extent as there cannot be constant successful output (Frenken, 2017). Secondly, fixing the market is only part of the solution. Attitude of the government towards innovation can also play a role, since if the government does not consider themselves competent in the innovation playground, there is only slight probability that there will be any well-defined, justified missions to complete. There will simply not be enough depth in the innovation process to be analyzed thoroughly which is required for investments that involve high risk. Finally, if the innovation policy is based on failure, market or system, the passive approach of market fixing does not consider the relationship between risk and reward (Mazzucato, 2016).

Shaping and creating markets, after fixing them, is more important these days than being satisfied with only fixing them. Dechezleprêtre et al. (2016) stress the fact that awareness of the demand side can help the government in directing the funding into correct places. Innovation that leads to socially respected benefits are often ignored by firms because they are not able to make the most out of them, which means that there should be higher incentive to make effort towards a societal challenge. Governments could look from the consumer perspective more when developing innovation policy. For example, car sharing in Switzerland was mainly developed by the drivers themselves. On one hand, this increases interactive innovation throughout the national innovation system, but on the other hand, it can mean rather difficult adjustments on the system so that it works on a larger-scale challenges (Grillitsch et al., 2019). More importantly, getting out of static innovation, where the focus is at one instance at a time, should be considered. Solution is to move to a more dynamic innovation by having multiple focus points between the inputs of the innovation system, such as innovation activities and processes, and the outputs, for example technological advancements or finding solutions to complex problems. Problems that often arise are usually lack of knowledge or financial constraints, which usually hinder the whole national innovation system (Fagerberg, 2017).

2.1.4. Effectiveness of Finnish Innovation Policy

Effectiveness of the Finnish innovation policy can be hard to measure, but after understanding the mechanics of the innovation policy, there are advantages and disadvantages involved with the Finnish innovation policy. The reason why the effectiveness should be somehow assessed, is because the worldwide innovation technologies have rapidly developed, and the competition has become stronger than ever before. Especially the countries in the Nordic and Scandinavia compete about their political appearance which not so much about winning, but it is more like getting the standards high (Ezell & Atkinson, 2010). This is crucial to know since Finland is not performing as well as it could in terms of their innovation and development. According to OECD (2017), Finnish innovation policy would be more effective through increased proactivity, faster decision making in addressing issues, and better transfer of knowledge in the innovation network. More interactive innovation system, increased diversification through more curiosity-driven innovation, and focus on societal and economic benefits would push the Finnish innovation policy forward (ibid). These are all important factors to remember when thinking of the innovation policy, since if one these is missing, the national innovation system is most likely not working effectively.

The Finnish innovation policy has shown a lot of potential over the past decades. This is mainly due to high level of social cohesion and trust, as well as good education which build upon already top socio-economic standards, such as low income inequality and well-being (Parella, 2019). Finland's national innovation system consists of high skilled and collaborative individuals who have strong instincts to provide change to the society (OECD, 2017; Parella, 2019). Sometimes the problem is that the new and social innovations can be made, but the existing ones need to be distributed better, which is one of the areas to develop in the Finnish innovation system (Aro & Heiskala, 2015). Another issue is balancing economics, social welfare, and ecological sustainability in one innovation policy. It seems that more weight is put on the economic growth as it can be measured quantitatively (Pulkka, 2012). This is problematic and can reduce the overall effectiveness the innovation policy since there can be too much room for interpretation which may lead to contradicting actions. Innovation towards accomplishing a societal challenge is not close to being efficient if there is too much

resources used in contemplating possible options and how to make them work suitably together.

Finland's challenge is to start acting as a more radical innovator. Now firms are concentrating too much on making safe and incremental innovations that rather slowly bring change to the society (OECD, 2017; Koski et al., 2019). The main limiting factor is the low number of capable firms that could change how Finnish citizens see the society. Therefore, it is vital to increase the number of Finnish start-ups by providing them support since many talented individuals also seek opportunities abroad (OECD, 2017). Also, start-ups often are often more ambitious to produce radical innovation than large companies (Koski et al., 2019). One good idea to continue is maintaining high reputation in education which will be socially effective in the long run as every citizen is included in the nationwide system (Parella, 2019). If Finland is unable to further develop their innovation policy in order to survive and adapt to the constant global change, there is a threat that Finland will lose some of its competitiveness. This leads to a vicious cycle of losing investments to innovation, general confidence decreases, labor is not utilized enough, and the overall capability to adjust to global environment might be more restrained than it should. Finland should continue using their strengths, such as the technological advancements in the ICT sector, to make more strengths in other sectors. This would increase the chances of attracting foreign investors. Addressing societal challenges, like carbon neutrality, should be made permanent in the innovation policy, since this brings social benefits as well as massive opportunities (OECD, 2017). Finland's innovation system has characters of strong specialization in forestry and machinery, but Finland should consider increasing the activity of SMEs to increase diversification and keep going with the current exploration of new policy logics (Cai et al., 2018).

Finland should look into possible bottlenecks in their innovation policy, such as financial constraints and lack of strategic uniformity in the national innovation system. It should be noted that currently Finland is performing relatively well when taking the situation into account, but the effectiveness of the innovation policy could be developed significantly further. It is time to move on and adapt to the global environment and consider new methods rather than focusing only on improving existing activity (Koski et al., 2019). Building upon existing strengths and addressing new knowledge-based

areas of high growth potential are essential to diversify, and they also provide opportunities to increase competitive advantage in these new areas of business (OECD, 2017). However, focusing too much on boosting exports and not concentrating on domestic business is not a good idea. Finding a suitable middle ground between exports and domestic growth needs to be considered (Ezell & Atkinson, 2010). In the next section, the use of innovation policy is discussed in relation with the target of Finland reaching carbon neutrality. A challenging societal challenge like this will highlight the importance of an efficient and an effective innovation system. If the system does not work efficiently, it could be altered through the innovation policy.

2.2. Carbon Neutrality and Finnish Innovation Policy

Now that the innovation policy and its purpose has been reviewed and understood on a more general level, this section will attempt to explore the use of Finnish innovation policy on the journey towards accomplishing a societal challenge, carbon neutrality. The concept of carbon neutrality is regularly on the news debates, and it is a topic that the Finnish Government has started to significantly address very recently. This could be looked at on a microlevel and focus on particular cities in Finland, but as the innovation policy should be uniform regionally across Finland, the policy will be looked at more macrolevel and from the perspective of the whole country. A majority of the methods will most likely concern energy production, but innovation policy is there to look for new ways of thinking and perhaps find solutions that are not so obvious. It should also be noted that innovation policy is not there just for reaching carbon neutrality, but it is also used in other purposes and most importantly, so that it fosters sustainable growth in Finland also after carbon neutrality is reached.

2.2.1. Enablers of and Barriers to Reach Carbon Neutrality

Initially the idea of becoming carbon neutral has come from multiple authorities, including the EU and the UN. According to the Paris Climate Accord, the countries part of the Paris Agreement need to achieve carbon neutrality by 2050. Finland is an ambitious country and have the target of reaching carbon neutrality in 2035. This is a

major societal challenge considering that most of the used energy in Finland still come from fossil fuels (Pilpola et al., 2019). Carbon neutrality is also part of the UN Sustainable Development Goals (SDGs). Before going too much in detail with the strategic aspects of the Finnish innovation policy and carbon neutrality target of Finland, a good level of understanding of the enablers (what makes carbon neutrality possible) and the barriers (what are the major challenges) needs to be acquired.

There are several enablers that make carbon neutrality possible. Various sectors are responsible of doing what they can to support the process, but the overall responsibility is on the policymakers themselves and the Finnish Government. For example, efficient energy production is one of the key elements when carbon neutrality is discussed. One action Finland takes is increasing the proportion of energy produced by wind. This is done through improving conditions of building wind plants onshore and offshore by removing administrative barriers (e.g. zone restrictions), and phasing out coal use in power plants (Karhunmaa, 2018; Valtioneuvosto, 2020). Other key sectors worth mentioning are buildings, transportation, and forestry (Lehtilä et al., 2014). More efficient heating methods also contribute to carbon neutrality (Heiskanen et al., 2011). Carbon can also be captured and stored in order to decrease the emissions, but it was found that it can be too challenging for Finland to implement in a large enough scale in order for it to be worthwhile (Lehtilä et al., 2014). Therefore, Finland should use resources elsewhere and focus on the sectors mentioned above which are more doable in a rather short period of time.

Buildings, commercial and households, are started to be constructed in a more environmentally friendly manner, which enables carbon neutrality through reduction of carbon footprint. For example, Vares et al. (2020) investigated and compared traditional log building with modified building that utilizes more modern materials such as better insulations. It was found that traditional and modified versions of buildings were both able to offset the emissions caused by the process of building and equipment used. The investigation was conducted in the arctic region of Finland, but it could be reflected into other regions as well. The main implication was that the lifetime of building materials should be extended as long as possible through secondary use (ibid). The benefit of wood construction as a carbon sink was also praised in the objectives outlined by Valtioneuvosto (2020). Another enabler of carbon neutrality is moving to low carbon transportation, such as electric vehicles or using biofuel as

sustainable alternative to fossil fuel. Innovation plays a valuable role in the process of turning cars and other modes of transportation to use renewable fuel or electricity. For example, Valmet Automotive has started manufacturing lithium battery packs for electric vehicles, which possibly enables Finland to boost their exports in the future (Wu et al., 2013). However, fast enough transition towards electric cars is challenging due to rather slow adoption of them (Lehtilä et al., 2014).

Finnish forests are in a significant role in enabling carbon neutrality since they not only act as a carbon sink, but they also remove carbon from the atmosphere in the process of carbon sequestration. Finland uses wood and logging residue as a source of bioenergy which reduces the use of fossil fuels like coal. However, it might have negative impact in the long-run if done in excess. This is partially due to carbon dioxide produced from biomass burning, but also logging removes nutrients and degrades the effectiveness of carbon sink, which decreases the net carbon reductions (Vanhala et al., 2013). Energy production from biomass is one step further already but reducing energy consumption is important too (Dahal & Niemelä, 2016). Heating uses around one fifth of all energy produced in Finland (Heiskanen, 2011). Some of the detached houses, in which half of all Finnish people live in, still have outdated heating systems that rely on oil or electric radiators. Finland enables its citizens to tax deduct heat pump system upgrades which should decrease the use of inefficient heating systems, thus decreasing carbon emissions (ibid). The use of fossil fuel in heating will be stopped in the 2030s (Valtioneuvosto, 2020).

During the progress of Finland becoming a carbon neutral country, there are also a couple of barriers that Finnish government, firms, and institutions involved in the national innovation system need to consider. According to Karhunmaa (2019), the Finnish parliamentary system works in a flexible manner and it seems to also unify differing views on acceptable technology. However, this is quite general starting point how the parliamentary system can help or limit the progress of becoming carbon neutral. Most of the time, the Finnish Government and the parliamentary debates focus on predictable solutions and rather safe approaches. Therefore, it is quite a high barrier and overcoming it requires to adopt a more brave and radical approach, such as being less shy in increasing innovation finance (Karhunmaa, 2019). Perhaps the actions are too optimistic. In addition, one barrier can also be the long time that is used to reach consensus between the political parties when it comes to different ideas and solutions

(Dahal & Niemelä, 2016). Koski et al. (2019) address this and suggest smoothing the process of making and implementing regulations, as it would enable faster adaptation to innovations and it would also enable better monitoring.

Another barrier in reaching carbon neutrality is the low attractiveness of incentives to produce renewable energy. For example, subsidies could be increased to promote renewable energy, like solar or wind, and reduce the use of coal (Dahal & Niemelä, 2016). The pace with which Finland is currently heading towards carbon neutrality is not enough. The study was done in the Helsinki Metropolitan Area, but it is likely that there is similar situation also elsewhere in Finland (ibid). Final challenge is to transform the Finnish innovation policy and related strategies accessible to everyone, and most importantly uniform across the national innovation system. Therefore, it is crucial that R&D and innovations are systematic, and that they are not only limited to regional or national level as they can have significant potential of increasing Finland's overall global competitiveness (Koski et al., 2019).

2.2.2. Strategy Towards Carbon Neutral Finland

Finland aims to reach carbon neutrality by 2035 by increasing net carbon sinks, for example through afforestation and by highlighting the use of carbon reduction measures, for example in construction (see 1.3.1). Reaching carbon neutrality requires monitoring and the progress will be assessed in 2025 which helps the government execute necessary updates to the innovation policy (Valtioneuvosto, 2020). Finnish innovation policy has relied on the larger companies, which is good since they have more resources to complete innovation projects. Hjelt et al. (2020) conducted a study on a range of large multinational companies in Finland. They interviewed the top management and investigated their perspectives on low carbon solutions. It was found that although low carbon solutions might have been initially considered as public image boosters, but now as a priority in most companies' agendas (ibid). Additionally, energy solutions related to heating and energy production, as well as clean transportation (see 1.3.1) are some of the most important aspects of the strategy towards carbon neutrality (Wu et al., 2013). It looks promising for Finland that it will reach carbon neutrality if technological developments are made successful in a relatively small timeframe.

However, it might not sustain any drawbacks such as financial difficulties (Lehtilä et al., 2014).

According to the Ministry of Economic Affairs and Employment, Finland will continue to maintain its competitiveness and increase productivity, as well as respond to carbon neutrality along with other societal challenges. Although it seems that Finland is performing well in the innovation field, the overall innovation system seems to be fragmented and not so connected, which can cause problems. The current innovation policy addresses these problems and highlights the bigger picture of innovation instead of focusing into smaller aspects (Koski et al., 2019). Dahal et al. (2018) suggest that reaching carbon neutrality should be focused on both national and city level, but it should not only address renewable and low carbon solutions, but also prevention measures on fossil fuels. It is important to keep innovation funding steady and progressive, which allows time for the development work (Dechezleprêtre et al., 2016).

Still, it is challenging for Finland to sufficiently address all the barriers when reaching carbon neutrality, but to fully utilize the innovation policy, Finland has to attempt to do its best. For example, Innovation Fund of Finland (Sitra) could be allowed more freedom in carrying out innovative experimenting without the need of the usual procedures through the parliamentary (OECD, 2017). This would streamline commercialization of innovation projects in the future if found effective. In addition, it is problematic when barriers are not fully seen as opportunities in climate strategies (Burch, 2009). For example, the funding of innovation projects that look into low carbon solutions and carbon neutrality, should be increased. This could be done by attracting of foreign investors (OECD, 2017). However, Finland is not able to put all innovative capacity into reaching carbon neutrality. Capacity is one of the critical barriers that needs attention, either by freeing capacity or creating more capacity (Burch, 2009).

2.3. Conceptual Framework

Now that the strategic side of the Finnish innovation policy has been reviewed, the enablers and barriers of reaching carbon neutrality have been explored, and how the Finnish innovation policy is tuned to accommodate smooth transition towards carbon neutrality has been understood, it is still necessary to conduct further analysis. In order to find ways how Finnish innovation policy could be tweaked and improved, it is valuable to compare the Finnish approach in reaching carbon neutrality to the approaches of other countries. This will also help in assessing the extent to which the Finnish innovation policy fosters sustainable development towards carbon neutrality.

Based on the literature review, there are three important aspects of the innovation policy which all play a vital role in the process of reaching carbon neutrality. First aspect is how government plans and implements the innovation policy to suit the carbon neutrality strategy, second aspect is how innovation is financed, and third interesting aspect is how different research organizations are involved in innovation towards carbon neutrality. Since all three are crucial and worthwhile to be compared with other countries, suitable perspectives to form the conceptual framework for this thesis (Figure 1 below) are therefore Governance, Innovation Finance and Research Organizations. In the upcoming sections, this framework will be used to answer the following research questions:

1) What differences are there between Finnish, Swedish and Norwegian innovation policies in how they help to reach carbon neutrality goals?
3) In what ways can Finland improve its innovation policy to reach carbon neutrality by 2035?

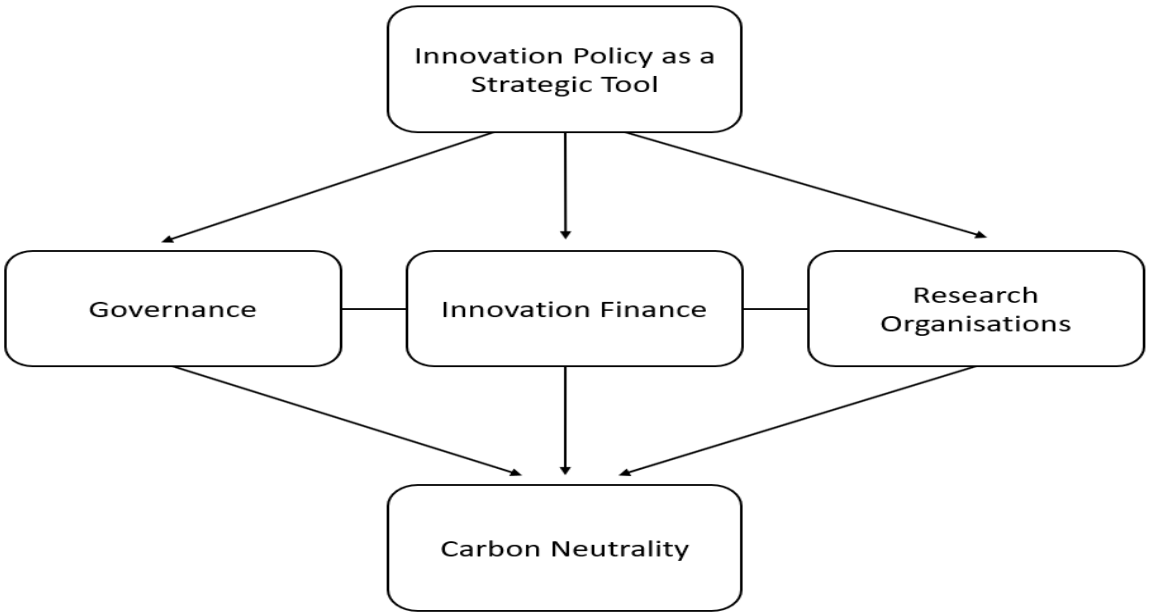

Figure 1: Conceptual Framework (Lassinen, 2021)

3. METHODOLOGY

This thesis employs desk research in a form of a comparison which aims to compare and benchmark the innovation policy strategy of Finland to Sweden and Norway in reaching carbon neutrality. This is done in terms of Governance, Innovation Finance and Research Organizations (see conceptual framework). The reason why Sweden and Norway are chosen to this study is because they not only belong to Nordic countries, but they also have similar values and objectives to Finland which makes them comparable with each other. This makes the benchmarking more likely to produce better suggestions for possible improvements.

3.1. Method

Benchmarking is the method used in this study. It is defined as “a tool by which an organization assesses how well it is meeting its objectives and how they could be met more effectively” (De La Porte & Pochet, 2001: 292). In this study the “organization” is Finland and the objective is carbon neutrality. This study will follow the benchmarking model below:

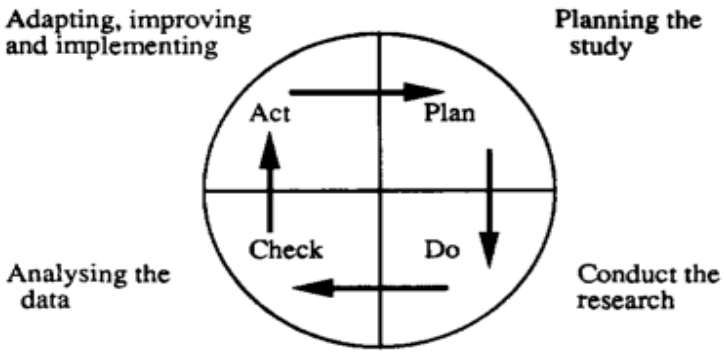

Figure 2: Benchmarking model following Deming Cycle (Lema & Price, 1995: 34)

Planning stage includes identifying the indicators that will be compared. Governance, Innovation Finance and Research Organization are each benchmarked using three indicators. For Governance, the indicators are carbon neutrality goals, the approach with innovation policy towards carbon neutrality, and the effectiveness of national innovation system. The indicators for Innovation Finance are gross domestic expenditure on R&D, government budget towards R&D and venture capital investments. Finally, the three indicators for Research Organizations are role of research organizations, such as research centers and universities, collaboration between them and innovation performance. After conducting the study, the findings are then summarized in a matrix after each dimension analyzed. Acting or implementation phase in this study is about the possible improvements Finland could do with their innovation policy and carbon neutrality strategy.

3.2. Data

The data used is mostly from OECD Statistics and OECD Reviews of Innovation Policy as there are comprehensive data on the issue which would be difficult to find elsewhere. The following studies conducted by Cai et al. (2018), Fagerberg & Fosaas (2014), Hall & Löfgren (2017), Laasonen et al. (2020) and Nordic Council of Ministers (2020) are also used in this study.

4. FINDINGS

The purpose of conducting the benchmarking of the Finnish innovation policy to the Swedish and Norwegian innovation policies and finding the relevant differences in their carbon neutrality strategies, was to find answers to the following research questions:

- What differences are there between Finnish, Swedish and Norwegian innovation policies in how they help to reach carbon neutrality goals?
- In what ways can Finland improve its innovation policy to reach carbon neutrality by 2035?

After the improvements are presented, the possibilities and ways how these could be implemented in Finland, are discussed in Chapter 5 (Discussion and Analysis).

4.1. Differences of Finnish, Swedish and Norwegian Innovation Policies in how they help in reaching Carbon Neutrality

Before presenting suggestions for the possible improvements to the Finnish innovation policy in Section 4.2., the differences between Finnish, Swedish and Norwegian innovation policies and how they help in reaching carbon neutrality are analyzed. The findings based on each dimension are presented in their respective subsections. Each subsection will end with a comparison matrix that collects all the relevant findings together based on the dimension compared.

4.1.1. Governance

Governance was the first dimension that was compared. First the goals to reach carbon neutrality were analyzed. A quite notable difference between Finland, Sweden and Norway is that they all have different targets and views on reaching carbon neutrality. Finland has the target of reaching carbon neutrality by 2035 (Valtioneuvosto, 2020), but Sweden for instance has the target of reaching zero net greenhouse gas (GHG) emissions by 2045, and Norway has the target of reaching climate neutrality by 2030

which are essentially the same thing (Nordic Council of Ministers, 2020). Carbon neutrality is part of the goals of each country, but they are expressed slightly differently which can lead to misinterpretation even though they mean the same. The numbers on decreasing the GHG emissions relative to 1990 are same for Norway and Finland at 55% decrease by 2030, and Sweden has a target of decreasing GHGs 75% which is more ambitious (ibid). Another interesting difference is that Norway and Sweden account the EU Emissions Trading System (ETS) into their targets, while Finland expects to achieve carbon neutrality by using national measures only. In 2018, the total emissions were almost at the same line – Finland 56.4 Mt, Sweden 51.8 Mt and Norway 52 Mt of CO_2eq (Nordic Council of Ministers, 2020). This is what highlights the use of time efficiently since especially the targets of Norway and Finland are quite near.

Then the governmental approach with innovation policy was compared. It seems that Finland has adopted a top-down or mission-oriented approach that allows more control to the government, whereas Norway's approach is more bottom-up. However, both have the problem of too much specialization: Finland is specialized in ICT and Norway in oil and gas (Cai et al., 2018). Sweden is specialized in global value chains and innovative services (OECD, 2016). Finland has increased their interest towards societal challenges through mission-oriented approach (Laasonen et al., 2020). Norway is more traditional, and relies on past performance, and has not yet progressed from heavy oil and gas specialization (Cai et al., 2018). Sweden on the other hand has less centralized control and more bottom-up and it relies on R&D driven innovation which is focused in solving societal challenges like carbon neutrality (Fagerberg & Fosaas, 2014). Evaluation of innovation policy performs weakly in Sweden due to uneven records (OECD, 2016). In Norway, there are well developed evaluation procedures (OECD, 2017b). There is no information on how well Finnish innovation policy is evaluated.

The effectiveness of the national innovation system and innovation policy was the final governance indicator that was compared. The importance of how effectively the system works is highlighted when carbon neutrality needs to be reached in relatively short timeframe. It seems that Finland is above Sweden and Norway in terms of coordination and sense of direction with the innovation policy (Fagerberg & Fosaas, 2014). It was also found out that Sweden's government structure is fragmented, which

makes innovation governance unclear (OECD, 2016; Hall & Löfgren, 2017). This is a threat for Finland if the Finnish government tries to contain a bit of everything in Finnish innovation policy without proper focus (Laasonen et al., 2020). Finland has determinately increased radical innovation, which is needed to reach carbon neutrality, yet there is no sort of best practice to follow (OECD, 2017a). Norway follows decentralized sectoral system with innovation, but it lacks vision and strong authority at the top, which in turn hinders decision-making (OECD, 2017b). Sweden on the other hand has a national innovation system that is not a mission-based, but instead it gives different agencies and innovation actors freedom to develop their own roles. This does not require much coordination from the government and the innovation performance is excellent, but it tends to stagnate and not move forward, which is due to lack of vision with societal challenges (OECD, 2016).

Table 1: Summary of Governance dimension

Country	Finland	Sweden	Norway
Carbon Neutrality targets			
Target year	2035 (carbon neutrality)	2045 (zero net GHGs)	2030 (climate neutrality)
Current emissions CO_2eq (in 2018)	56.4 Mt	51.8 Mt	52 Mt
GHG target decrease relative to 1990 by 2030	55%	75%	55%
Innovation Policy Approach			
Specialization	ICT	high end of global value chains and innovative services	oil and gas
Interest in societal challenges	high	medium	high
Orientation	mission-oriented	bottom-up	bottom-up
Evaluation	present (unsure how good)	poor	well-functioning
Effectiveness of National Innovation System and Innovation Policy			
Decision-making	centralized, starting to decentralize more	decentralized, gives freedom to innovation actors	decentralized, lacks authority at the top
Innovation performance	Good, but there could be more radical innovation	Excellent, but tends to stagnate	Satisfactory, but strongly reliant on past performance
Coordination	determined, no best practice to follow	fragmented, unclear	complex sectoral system, not systematic
Vision on societal challenges	low	low	low

4.1.2. Innovation Finance

Innovation finance and how it is different in Finland, Sweden and Norway was the next dimension compared. All of the figures included in this section are based on latest data available from OECD. In addition, all of the values are either US dollars or national currencies converted into Purchasing Power Parity (PPP) dollars.

First indicator compared was the overall government domestic expenditure on R&D, which also includes R&D funding coming from abroad. In 2018, Norway and Finland spent the same amount of $6.9 billion on R&D, whereas Sweden used $17.1 billion which is around 2.5 times more (OECD, 2021b). However, these values should be compared in terms of how large proportion they take from GDP. As shares of GDP, Finland used 2.8%, Norway 2.1% and Sweden 3.3% towards R&D (ibid). However, these amounts are not all for towards innovation, at least not towards solving societal challenges like carbon neutrality, but there is still a connection between R&D and innovation (Fagerberg & Fosaas, 2014).

Second innovation finance indicator compared was government budget outlays for R&D. There is no accurate information of how much is budgeted towards reaching carbon neutrality, but OECD has data on budget outlays towards environment and energy. In 2019, Finland's total government budget outlay for R&D was $2.37 billion from which $54.88 million was towards the environment and $56.88 million towards energy R&D (OECD, 2021a). In Sweden, total in 2019 was $4.23 billion from which $74.09 million was towards environment and $179.40 million towards energy. Finally, Norway's total was $3.66 billion from which $98.00 million and $101.25 million towards environment and energy respectively (ibid).

Third and final indicator that was compared between Finland, Sweden and Norway was figures on venture capital investments. These are also valuable figures to compare as venture capital investments play a significant role supplying financing for innovation activity and start-ups (Fagerberg & Fosaas, 2014). In 2019, venture capital investments were $323.81 million in Finland, $151.35 million in Norway and $403.53 million in Sweden (OECD, 2021c). Norway is quite far behind from Sweden and Finland.

Table 2: Summary of Innovation Finance dimension

Country	Finland	Sweden	Norway
Overall government expenditure on R&D			
Total	$6.9 billion	$17.1 billion	$6.9 billion
As a share of GDP	2.8%	3.3%	2.1%
Government budget outlays for R&D			
Total	$2.37 billion	$4.23 billion	$3.66 billion
Energy	$56.88 million	$179.40 million	$101.25 million
Environment	$54.88 million	$74.09 million	$98.00 million
Venture capital investments			
In 2019	$323.81 million	$403.53 million	$151.35 million

4.1.3. Research Organizations

Research organizations was the last dimension compared. This dimension includes the role of research organizations, innovation performance, and collaboration. Roles of research organizations in Finland, Sweden and Norway were found to have interesting differences. In Norway, public research organizations are playing as key actors in the innovation system, who provide applied research for industry and public sector. The problem is that there is too little attention given to systemic change, and too much on basic knowledge about societal challenges (OECD, 2017b). Sweden on the other hand focuses on funding universities on their third mission, which is to address societal challenges. In addition, Sweden launched UDI Programme in 2009, which is about challenge-driven innovation towards accomplishing societal challenges (OECD, 2016). Finland also focuses on third mission, but government research institutes are in key role. Further experimentation on how to apply this knowledge needs to be investigated (OECD, 2017a). It was found that in Sweden, reducing performance-based funding and giving more freedom to universities and other research organizations to execute their own strategic funding decisions, has improved Swedish innovation system (OECD, 2016). Heavy performance-based funding limits Finnish innovation system due to restrictions on universities' ability to use strategic resources. In addition, it was found that Finland should provide more attention on how to research concrete solutions to societal challenges (OECD, 2017a).

Innovation performance has increased in terms of new publications in Norway, but the country still needs more high-quality research groups. In addition, based on how much Norway finances innovation (see section 4.1.2), the innovation output is less than expected (OECD, 2017b). Finland has high performance, but even with strong theory-based knowledge, it struggles to deploy knowledge into action and solve societal challenges like carbon neutrality (OECD, 2017a). High performance in research has been a quality of Sweden for a long time, however; now it seems that they are stuck to keep up in terms of quality innovation, and the focus is on academic research. Sweden has implemented prioritization strategy to exclude irrelevant research, but that is limited by the ineffective governance (OECD, 2016).

Finally, degree of collaboration between research organizations was compared. It was found that Norway has close relationships between research institutes and universities which is shown in joint projects and co-publications. Norway could also increase competitiveness to encourage innovation (OECD, 2017b). It looks like Norwegian universities have started to be more and more involved with societal challenges, but as was discussed earlier, the complex sectoral system and lack of vision result in weak cross-sectoral collaboration (ibid). In Sweden, collaboration has resulted in competitive research and teamwork in programmes, as well as coordination of activities between involved organizations, but at the same time it has increased financial commitment in collaborative projects (OECD, 2016). This is an area Finland could do better in. Networking research organizations with universities could increase not only collaboration, but also help building specialization and deploying knowledge which was another struggle of the Finnish system (OECD, 2017a).

Table 3: Summary of Research Organizations dimension

Country	Finland	Sweden	Norway
Role of research organizations			
Societal challenges	Attention required how to research concrete solutions to societal challenges	UDI Programme, challenge-driven innovation	universities very involved, but too little attention given to systemic change
Key actor in innovation system that helps reaching carbon neutrality	government research institutions	universities	public research organizations
Innovation Performance			
Quality	high	high but maybe not always relevant	high, but needs more research groups
Deployment of knowledge	weak – Finland should seek ways to apply research	strong, shows prioritization	quite strong, but less than expected
Focus	Theory-based research	academic research	applied research for industry and public sector
Collaboration			
Competitiveness	could be more competitive	competitive	could be more competitive
Degree of collaboration	weak	strong horizontally	weak due to complex sectoral system

4.2. Possible Improvements to Finnish Innovation Policy

Based on the differences discussed previously, there are few possible improvements that could be made to the Finnish innovation policy. Tuning the innovation policy is particularly important to ensure smooth transition to carbon neutrality. In addition, there is limited time available, so suggestions for improvements are needed. This is the stage of adapting on the benchmarking cycle (Figure 2).

Based on what was found in Governance dimension (Section 4.1.1.), there are three possible improvements that could be made to Finnish innovation policy. First, learning from Sweden, decision-making in Finnish innovation policy could be made more decentralized because innovation was found to be successful due to innovation actors

having more freedom. It is necessary to keep in mind that effective authority at the top is required. Second, well established innovation policy evaluation system could be implemented so that Finnish innovation policy would be continuously evaluated during the process of reaching carbon neutrality. Third and final improvement based on the findings from this dimension is having a common and crystal-clear vision about reaching carbon neutrality. This would make Finnish innovation policy even more determined, and it would not be fragmented like the Swedish system nor too complex and inefficient, like the system in Norway.

Improvements in terms of Innovation Finance (Section 4.2.2.) on one hand could be increasing expenditure in every aspect. On the other hand, as Table 2 shows, Sweden uses about 2.5 times more funding in R&D overall which does not mean that their innovation is 2.5 times better than in Finland. Therefore, Finland should consider increasing R&D budget gradually and see how it helps reaching the targets set by the government. Focus should be on increasing financing towards environment and energy innovation. Increasing expenditure towards them would be a viable option because venture capital investments are already at a similar level as in Sweden.

Based on the last dimension, Research Organizations (Section 4.1.3.), Finland should consider a couple of improvements. First, learning from Norway, Finnish innovation policy could be improved by finding out how to apply research more into finding concrete solutions to societal challenges, especially how to reach carbon neutrality. Second, degree of collaboration between research organizations in Finland is weak compared to Sweden. As was already discussed, increasing collaboration would increase competitiveness and encourage teamwork. In Sweden, this shows in better deployment of knowledge (see Table 3).

5. DISCUSSION AND ANALYSIS

Referring to Section 4.2., first finding was that Finnish innovation policy should consider making decision-making more decentralized and implement an evaluation system. Second finding was that Finland should build uniform vision across the Finnish national innovation system on how to reach carbon neutrality and overcome all the

challenges. OECD (2017) suggests that Finland could develop a platform on which all relevant stakeholders can interact and share knowledge. This would play a vital role since a systemic perspective is required to reach carbon neutrality with coherence (OECD, 2017). This is something Finland should address as soon as possible, but it is likely to happen and succeed at least to some extent.

Third finding is that due to Finland having rather low degree of collaboration (refer to Table 3), this system discussed above would not only give uniform vision to everyone involved, but it would also increase collaboration between research organizations. In addition, it would boost competitiveness which would then increase innovation performance like was found in Sweden (OECD, 2016).

Finally, there is the most difficult aspect of innovation policy to improve. Last finding discussed how increasing innovation finance, budget outlay and overall government expenditure with focus to environment and energy innovation could benefit Finland in reaching carbon neutrality (see Section 4.1.2). This is only true if Finland concentrates in making not only smart but also fast decisions on how to apply research to innovate concrete solutions. Deployment of knowledge has been a weak link for Finland as was discussed in 4.1.3. The target year of 2035 is in 14 years which is quite a short time so there is not much room to wait or mistakes (Valtioneuvosto, 2020). Increasing the budget outlay will be difficult, especially during difficult financial times, and it will be likely that the required funds will be cut from another important area. The amount needs to be experimented and perhaps gradually increased if needed and found necessary.

6. CONCLUSIONS

The concluding chapter of this thesis focuses on summarizing main findings, giving useful implications to general business world, providing limitations concerning the study, and finally ending with suggestions for further research avenues.

6.1. Main Findings

Main findings of this study are presented as short answers to the research questions of this paper:

1) What differences are there between Finnish, Swedish and Norwegian innovation policies in how they help to reach carbon neutrality goals?

This study found that decentralized decision-making in Sweden helps by giving from freedom to the actors involved in innovation. In addition, Norway has a well-functioning evaluation system which enables continuous assessment of innovation performance. Norway also applies research better than Sweden and Finland, which is vital in making concrete solutions that can be used to reach carbon neutrality. The difference in larger innovation finance can also be helpful in reaching carbon neutrality goals as long as funding is used effectively and for relevant projects. Last difference that can be seen helpful in reaching carbon neutrality is having more collaboration between research organizations as it increased innovation performance.

2) What are the enablers of carbon neutrality and barriers to reach carbon neutrality?

Enablers of carbon neutrality are improving carbon sinks (e.g. wood construction), using biomass to produce energy, increasing proportion of energy produced by wind, changing to more efficient heating such as heat pumps, and adopting low carbon transportation methods such as electric cars. One barrier to reach carbon neutrality is the attitude of government which focuses on predicable solutions and safe approaches, when it should be more radical in reaching carbon neutrality. Additional barriers are the low attractiveness of incentives to produce renewable energy and the challenge of making Finnish innovation policy accessible and uniform across the national innovation system.

3) In what ways can Finland improve its innovation policy to reach carbon neutrality by 2035?

One way to improve Finnish innovation policy is to make decision-making decentralized because it gives more freedom to innovation actors. Second way is to implement an evaluation system or a platform which will gather all relevant stakeholders together which would make Finland's approach towards carbon neutrality more systemic and increase collaboration through more competition. Third way to improve Finnish innovation policy is to increase government R&D budget and expenditure towards innovation activities that help reaching carbon neutrality. Each of these ways should be addressed to make the innovation policy as effective as possible and ensure reaching carbon neutrality by 2035.

6.2. Implications for International Business

The findings from this thesis can have useful implications to policymakers who are not only involved with innovation policy, but also with innovation in general and societal challenges like carbon neutrality. The focus in this paper was on benchmarking the Finnish innovation policy and its use to reach carbon neutrality against Sweden and Norway, but similar findings could be found with other countries. This is most likely to happen if the countries are similarly comparable, like the Nordic countries used in this thesis. From government's perspective, it is useful to benchmark own policies to find what kind of strategies other countries have with any policy, not just with innovation policy and its use in reaching carbon neutrality.

6.3. Limitations

There are a few major limitations with the study conducted in this thesis. First quite major limitation to the benchmarking study was lack of literature that compare Finnish innovation policy with any other countries' innovation policies in regard to carbon neutrality. Most of the data and findings are from OECD in this study. OECD is a very reputable organization, but the overall perspective comes from few sources from the

same organization. This might have negative effect on how well the findings can be used.

Second limitation concerns benchmarking itself. In this study Finland, Sweden and Norway were compared in three dimensions: governance, innovation finance and research organizations. However, the benchmarking only used the latest data available for convenience, the findings can be too general caused by absence of detail and data trends over the years.

Final significant limitation is that due to limited time available, it was not possible to conduct interviews with relevant stakeholders who are working with the Finnish innovation policy. This would have resulted in additional perspectives on the Finnish innovation policy and perhaps on what plans Finland has for improving it in the near future.

6.4. Suggestions for Further Research

Based on what was found in this study and concerning the method used, there are a couple of suggestions for further research. Main idea for further research would be to benchmark Finnish innovation policy against some other countries (e.g. Germany or Denmark) to get broader overview on the performance of Finnish innovation policy. This would then likely produce further suggestions for improvements. Comparing with China or United States would also be interesting, but that might not result in relevant improvements to Finnish innovation policy.

Another suggestion for further research could be conducting similar benchmarking closer to the target years of reaching carbon neutrality. This would be interesting to see whether Finland's or any other country's carbon neutrality strategy in terms of innovation policy has been changed and improved.

Final suggestion could be doing a more thorough analysis of the innovation policy strategies and perhaps get access to relevant stakeholders for interviews. This would bring further perspectives on the innovation policies and up-to-date strategies of reaching carbon neutrality.

7. References

Alaja, A. (2017). 'Yrittäjähenkinen Valtio. Uusi Avaus Innovaatiopolitiikkaan' (Entrepreneurial State. A New Opening For Innovation Policy). [PDF]. *Kansantaloudellinen aikakausikirja:* 113: 121-140.

Aro, J. & Heiskala R. (2015). 'The Finnish Innovation System and Innovation Policy.' [PDF]. *CRESSI Working Papers:* 22: 2-14.

Burch, S. (2010). 'Transforming Barriers Into Enablers Of Action On Climate Change: Insights from Three Municipal Case Studies in British Columbia, Canada.' *Global Environmental Change;* 20(2): 287-297. Retrieved from: ScienceDirect [Accessed on 18 December 2020].

Cai, Y., Normann, R., Pinheiro, R. & Sotarauta, M. (2018). 'Economic Specialization And Diversification At The Country And Regional Level: Introducing a Conceptual Framework To Study Innovation Policy Logics.' *European Planning Studies*; 26 (12): 2407-2426. Retrieved from: Taylor & Francis Online [Accessed on 21 November 2020].

Dahal, K., Juhola, S. & Niemelä, J. (2018). 'The Role Of Renewable Energy Policies For Carbon Neutrality In Helsinki Metropolitan Area.' *Sustainable Cities and Society;* 40: 222-232. Retrieved from: ScienceDirect [Accessed on 18 November 2020].

Dahal, K. & Niemelä, J. (2016). 'Initiatives Towards Carbon Neutrality In The Helsinki Metropolitan Area.' *Climate* [online]. 4(3): 36. Available at: https://doi.org/10.3390/cli4030036 [Accessed on 18 December 2020].

Dechezlepretre, A., Martin, R. & Bassi, S. (2016). *Climate Change Policy, Innovation and Growth.* [PDF]. Grantham Research Institute on Climate Change and the Environment, Global Green Growth Institute (GGGI), London School of Economics and Political Science.

De La Porte, C. & Pochet, P. (2001). 'Social Benchmarking, Policy Making and New Governance in the EU.' *Journal of European Social Policy*; 11 (4): 292.

Ezell, S.J. & Atkinson, R.D. (2010). 'The Good, The Bad, and The Ugly (and The Self-Destructive) of Innovation Policy: A Policymaker's Guide to Crafting Effective Innovation Policy.' [PDF]. *The Information Technology and Innovation Foundation:* 2-107.

Fagerberg, J. (2017). 'Innovation Policy: Rationales, Lessons And Challenges.' *Journal of Economic Surveys* [online]. 31(2). 497-512.

Fagerberg, J. & Fosaas, M. (2014). 'Innovation and Innovation Policy in the Nordic Region' Available at: https://mpra.ub.uni-muenchen.de/56114/ [Accessed 3 March, 2021].

Frenken, K. (2017). 'A Complexity-Theoretic Perspective on Innovation Policy' *Complexity, Innovation and Policy [online].* 35-47.

Grillitsch, M., Hansen, T., Coenen, L., Miörner, J. and Moodysson, J. (2019). 'Innovation Policy For System-Wide Transformation: The Case of Strategic Innovation Programmes (SIPs) in Sweden.' *Research Policy*: 48(4): 1048-1061.

Hall, P. & Löfgren, K. (2017). 'Innovation Policy as Performativity – The Case of Sweden.' *International Journal of Public Administration*; 40(4): 305-316.

Heiskanen, E., Lovio, R. & Jalas, M. (2011). 'Path Creation For Sustainable Consumption: Promoting Alternative Heating Systems in Finland.' *Journal of Cleaner Production;* 19: 1892-1900.

Hjelt, M., Hietala, K., Sepponen, S., Sirppiniemi, R. & Luoma, P. (2020). *Finland On The Road To A Carbon-Neutral Society – Business Finland's Role In Promoting Low-Carbon Solutions.* [PDF]. Business Finland. Available at: https://www.businessfinland.fi/4a5a87/globalassets/finnish-customers/02-build-your-network/bioeconomy--cleantech/alykas-energia/bf-ja-vahahiilisyys-impact-brief_2020.pdf [Accessed on 3 January 2021].

Karhunmaa, K. (2019). 'Attaining Carbon Neutrality in Finnish Parliamentary and City Council Debates.' Futures; 109: 170-180. Retrieved from: ScienceDirect [Accessed on 17 November 2020].

Koski, O., Husso, K., Kutinlahti, P., Huuskonen, M. & Nissinen, S. (2019). 'Outlook For Finland's Innovation Policy.' *Publications of the Ministry of Economic Affairs and Employment* [online]. 18: 11-80.

Laasonen, V., Kolehmainen, J. & Sotarauta, M. (2020). 'The Complexity of Contemporary Innovation Policy and its Governance in Finland.' *Innovation: The European Journal of Social Science Research: 1-18.* doi: 10.1080/13511610.2020.1842176

Lehtilä, A., Koljonen, T., Airaksinen, M., Tuominen, P., Järvi, T., Laurikko, J., Similä, L. & Grandell, L. (2014). *Low Carbon Finland 2050 -platform.* [PDF]. VTT.

Lema, N.M. & Price, A.D.F, (1995). 'Benchmarking: Performance Improvement Toward Competitive Advantage.' *Journal of Management in Engineering*; 11(1): 34.

Mazzucato, M. (2016). 'From Market Fixing to Market-creating: A New Framework For Innovation Policy.' *Industry and Innovation.* [online]. 23(2). 140-156. Retrieved from: Taylor & Francis Online [Accessed on 29 November 2020].

Mazzucato, M. (2018). 'Mission-oriented Innovation Policies: Challenges And Opportunities' *Industrial and Corporate Change*.' [online]. 27(5). 803-815.

Nordic Council of Ministers. (2020). *The Road Towards Carbon Neutrality In The Different Nordic Countries.* Available at: https://www.norden.org/en/publication/road-towards-carbon-neutrality-different-nordic-countries [Accessed on 7 March 2021].

OECD. (2016). *OECD Reviews Of Innovation Policy: Sweden 2016.* Available at: https://www.oecd.org/sweden/oecd-reviews-of-innovation-policy-sweden-2016-9789264250000-en.htm [Accessed on 3 January 2021].

OECD. (2017a). *OECD Reviews Of Innovation Policy: Finland 2017.* Available at: https://www.oecd.org/finland/oecd-reviews-of-innovation-policy-finland-2017-9789264276369-en.htm [Accessed on 3 January 2021].

OECD. (2017b). *OECD Reviews Of Innovation Policy: Norway 2017.* Available at: https://www.oecd.org/norway/oecd-reviews-of-innovation-policy-norway-2017-9789264277960-en.htm [Accessed on 3 January 2021].

OECD. (2021a). *Government Budget Allocations For R&D.* Available at: https://stats.oecd.org/viewhtml.aspx?datasetcode=GBARD_NABS2007&lang=en# [Accessed on 7 March 2021].

OECD. (2021b). *Gross Domestic Spending On R&D.* Available at: https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm. [Accessed on 7 March 2021].

OECD. (2021c). *Venture Capital Investments.* Available at: https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST# [Accessed on 7 March 2021].

Parella, J.F. (2019). 'The Success of the Finnish Model: An Economic Analysis' *Journal of Management Policies and Practices.* [online]. 7(1). 12-20.

Pilpola, S., Arabzadeh, V., Mikkola, J. & Lund, P.D. (2019). 'Analyzing National And Local Pathways To Carbon-Neutrality From Technology, Emissions, And Resilience Perspectives – Case Of Finland.' *Energies* [online]. 12(5): 949.

Pulkka, L. (2012). 'Luova Kestävyys. Ekologinen Kestävyys Työ- ja Elinkeinoministeriön Innovaatiopolitiikassa.' (Creative Sustainability. Ecological Sustainability of Innovation Policy of Ministry of Economic Affairs and Employment). *Aalto-yliopiston julkaisusarja CROSSOVER.* 22: 1-114.

Suorsa, K. (2007). 'Regionality, Innovation Policy And Peripheral Regions in Finland, Sweden and Norway.' *Fennia*: 185(1): 15-29.

Takalo, T. & Toivanen, O. (2018). *Economics of Finnish Innovation Policy.* [PDF]. Talouspolitiikan arviointineuvosto.

Valtioneuvosto. (2020). *3.1 Carbon Neutral Finland That Protects Biodiversity.* Marin's Government Programme. Available at: https://valtioneuvosto.fi/en/marin/government-programme/carbon-neutral-finland-that-protects-biodiversity [Accessed on 22 December 2020].

Vanhala, P., Repo, A. and Liski, J. (2013). 'Forest Bioenergy At The Cost Of Carbon Sequestration?' *Current Opinion in Environmental Sustainability* [online]. 5: 41-46.

Vares, S., Savolainen, P., Häkkinen, T., Shemeikka, J., Huttunen, M. & Zubillaga, L. (2020). ‘Concepts And Type Building For Carbon Neutral Construction In Arctic Finland Based On Traditions.’ *IOP Conference Series: Earth and Environmental Science* [online]. 588: 1-4.

Wu, Q., Møller, J. G., Østergaard, J., & Nielsen, A. H. (2013). ‘Policies And Initiatives For Carbon Neutrality In Nordic.’ *Journal of Energy and Power Engineering* [online]. 7: 1745-1753.